Learning Collateral Price

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University of St Andrews
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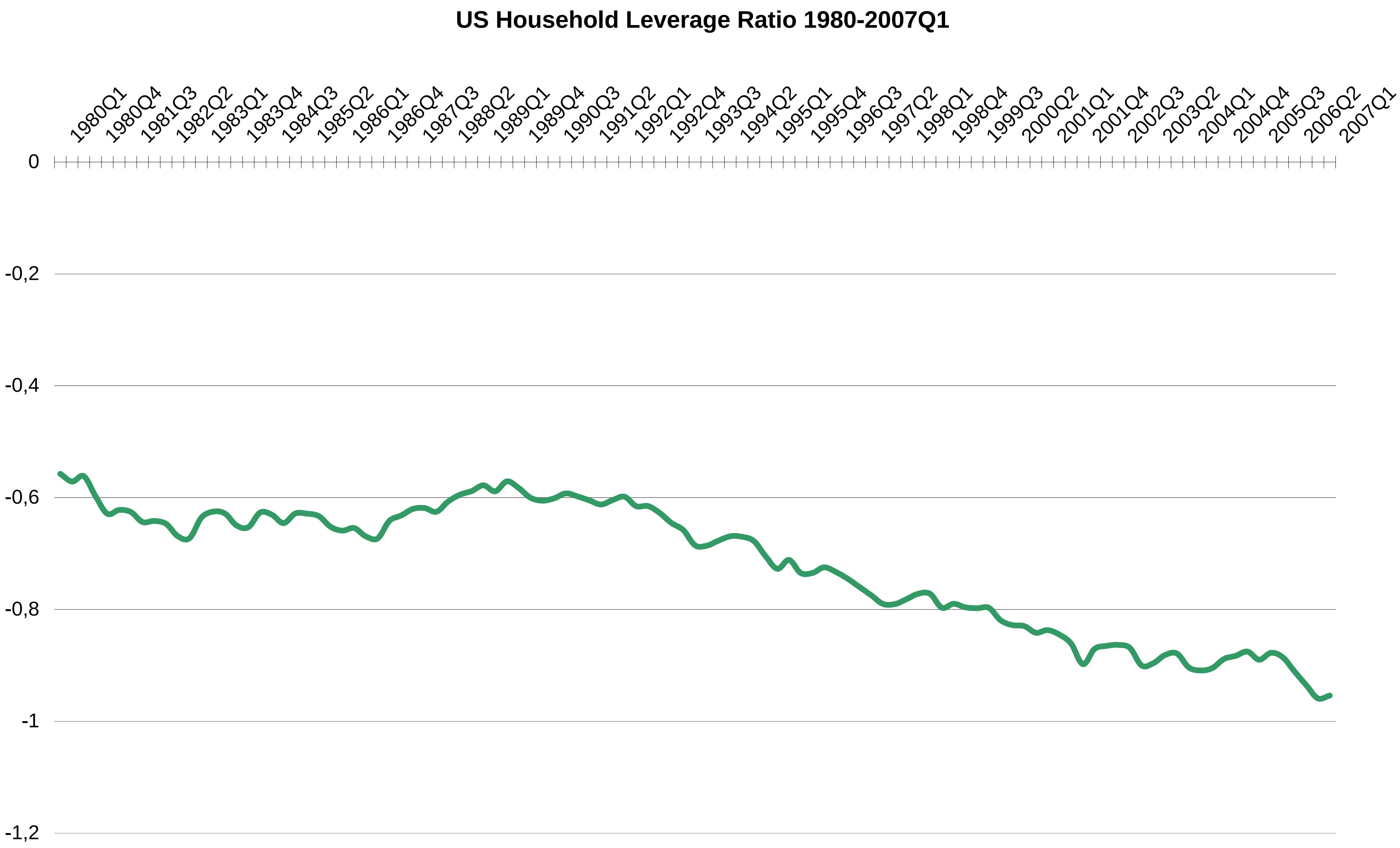
US Household Leverage Ratio 1980-2007Q1
0
-0,2
-0,4
-0,6
-0,8
-1
-1,2
1980Q1
1980Q4
1981Q3
1982Q2
1983Q1
1983Q4
1984Q3
1985Q2
1986Q1
1986Q4
1987Q3
1988Q2
1989Q1
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- **Household leverage ratio rose from about** 0.64 **to about** 0.93**!**

- **Contrasts with flat leverage during 1980-1995 period**

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  - rise in housing prices perceived as reduction in default risk
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- **Model based on Kiyotaki-Moore (JPE,97), Iacoviello (AER,05)**

- **We add two new assumptions:**
  (i) **adaptive learning** *à la* **Evans-Honkaphoja**
  (ii) **procyclical leverage**

- **Key parameter: elasticity of leverage w.r.t. housing price**

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- (i) **if leverage acyclical:**
  impact of TFP shocks slightly more persistent (compared to RE)
  (ii) **if leverage procyclical:**
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- **Our results suggest that impact of learning under collateral constraints is magnified by leverage procyclicality**

- **Literature about learning under collateral constraints:**
  - **Geanakoplos (2009), Cao (2011) with procyclical leverage**
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- **Road map:**
  1. **Simple model with learning under procyclical leverage**
  2. **Pseudo impulse response functions to TFP shock**
  3. **Conclusion**

1. Simple model with learning under procyclical leverage

- **Lenders (patient) and borrowers-producers (impatient)**

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- **Lenders maximize**

$$E_0^* \sum_{t=0}^{\infty} \tilde{\beta}^t \left[\frac{\tilde{C}_t^{1-\sigma_L}}{1-\sigma_L} + b \frac{\tilde{L}_t^{1-\sigma_W}}{1-\sigma_W} \right]$$

s.t.

$$\tilde{C}_t + Q_t(\tilde{L}_{t+1} - \tilde{L}_t) + B_{t+1} = (1 + R_t) B_t$$

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- **Borrowers have $\beta < \tilde{\beta}$ and produce**

$$Y_t = AK_t^{\alpha} L_t^{\gamma}$$

- **Borrowers maximize**

$$E_0^* \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\sigma_B}}{1-\sigma_B}$$

s.t.

$$C_t + K_{t+1} - (1-\delta)K_t + Q_t(L_{t+1} - L_t) + (1+R_t)B_t = B_{t+1} + AK_t^{\alpha}L_t^{\gamma}$$

$$E_t^*[\Theta_t Q_{t+1} L_{t+1}] \geq E_t^*[(1+R_{t+1})B_{t+1}]$$

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$$E_t^*[\Theta_t Q_{t+1} L_{t+1}] \geq E_t^*[(1+R_{t+1})B_{t+1}]$$

- **Land in fixed supply:**

$$L_t + \tilde{L}_t = \bar{L}$$

- **We assume that in the aggregate:**

$$\Theta_t = \theta_t \left\{ \frac{Q_{t+1}}{Q^*} \right\}^{\varepsilon}$$

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- **Above formulation captures in a simple way the fact that leverage ratio may be elastic to housing prices**

- **1996-2006 decade features** $\varepsilon > 0$ **(**$\neq \varepsilon \approx 0$ **in 1980-96)**

- **However, regulation could also deliver** $\varepsilon < 0$

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$$X_t = \mathcal{A}X_{t-1} + \mathcal{B}E^*_{t-1}X_t + \mathcal{C}E^*_t X_{t+1} + \mathcal{D}u_t$$

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- **RE Minimal State Variable equilibrium:**

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- **Perceived Law of Motion has same form:**

$$X_t = \mathcal{M}X_{t-1} + \mathcal{G}u_t$$

- **Agent beliefs used to forecast :**

$$E_{t-1}^{*} X_t = \mathcal{M}_{t-1} X_{t-1} \quad \textbf{and} \quad E_t^{*} X_{t+1} = \mathcal{M}_t X_t$$

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2. Pseudo impulse response functions to TFP shock

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2. Pseudo impulse response functions to TFP shock

- **Question we ask:**
  what is the economy's response to a TFP shock?

- **Benchmark parameter values are as follows**

Table 1. Parameter Values

θ	$\tilde{\beta}$	β	α	γ	δ	σ_W	σ_L	σ_B	ρ
0.64	0.99	0.95	0.35	0.05	0.025	1	1	2	0.95

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- **Model log-linearized around steady state:**
  learning dynamics differ from RE dynamics only if beliefs initially not consistent with REE

- **Suppose first that:**
  - **leverage is** *acyclical* **(**$\varepsilon = 0$**)**
  - **beliefs underestimate VAR coefficients by** 10%
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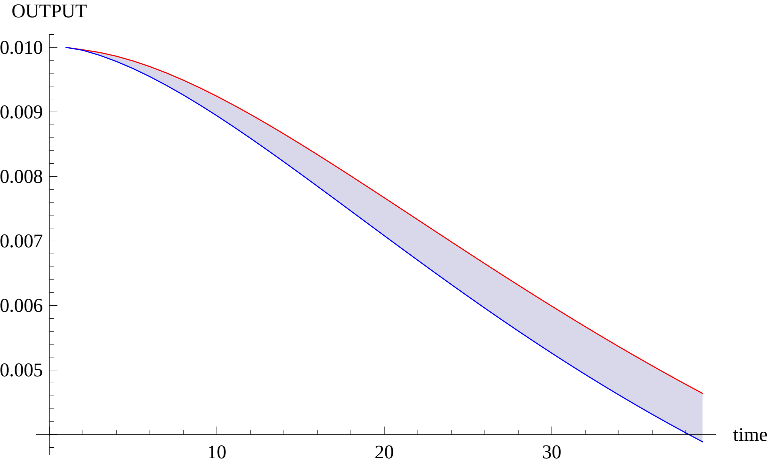
- **Pseudo impulse responses to a** 1% **TFP shock**

- **In all figures below:**
  - **red curves stand for learning**
  - **blue curves stand for REE**


OUTPUT
0.010
0.009
0.008
0.007
0.006
0.005
10
20
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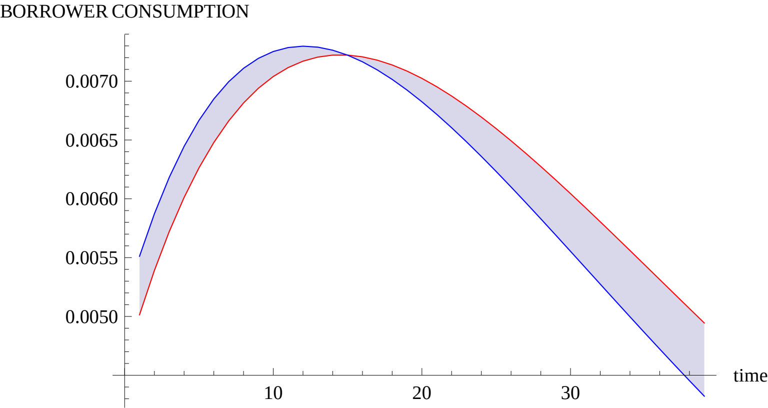
time


BORROWER CONSUMPTION
0.0070
0.0065
0.0060
0.0055
0.0050
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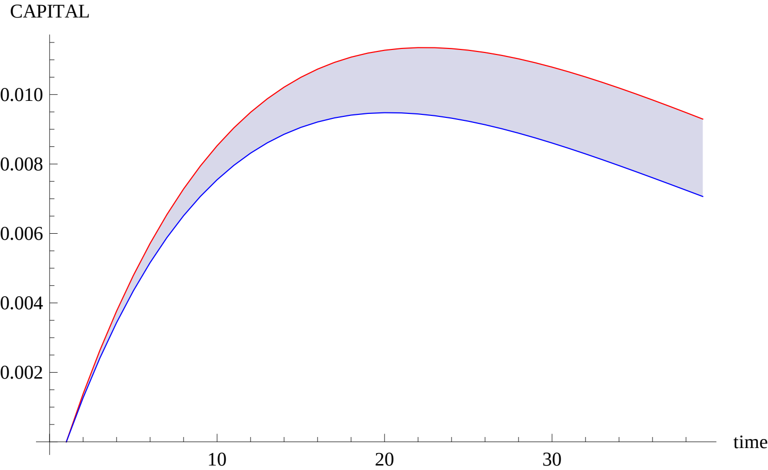
CAPITAL
0.010
0.008
0.006
0.004
0.002
10
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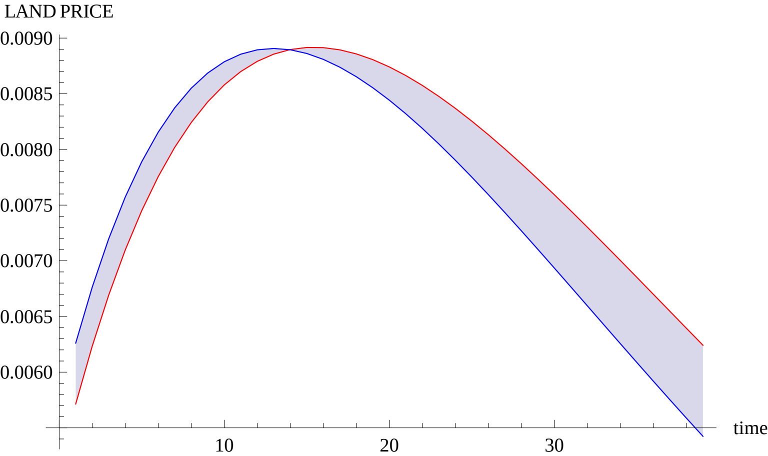
time


LAND PRICE
0.0090
0.0085
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0.0075
0.0070
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0.0060
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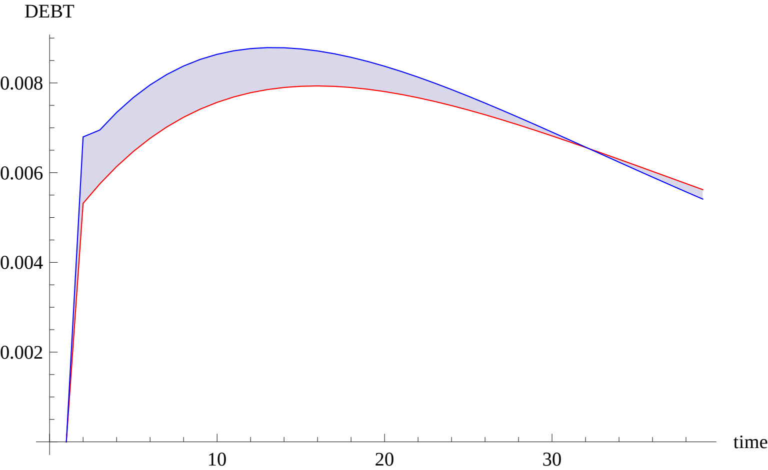
DEBT
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- **Intuition for learning effect under acyclical leverage:**
  - **learning enhances intertemporal substitution in consumption**
  - **large initial reaction of investment in collateralized asset**
  - **procyclical credit constraints relaxed**
  - **more persistent effect on output**

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- **By and large, learning implies slightly larger persistence**

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  - **- beliefs underestimate VAR coefficients by** 10%
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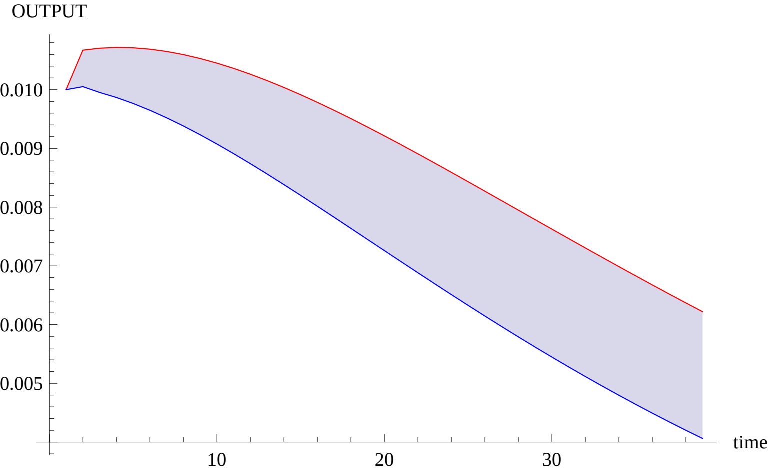

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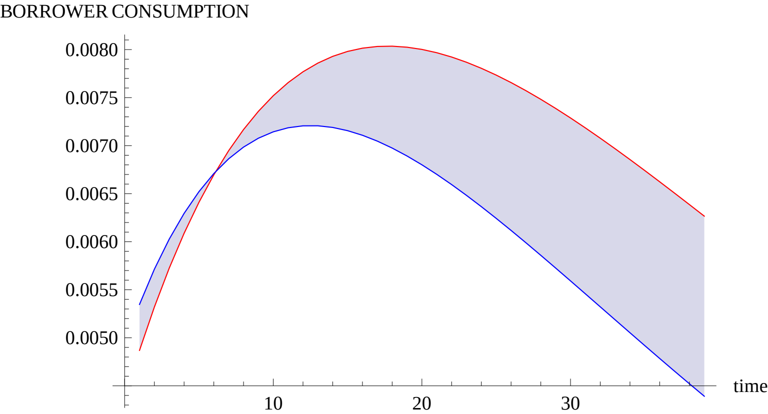
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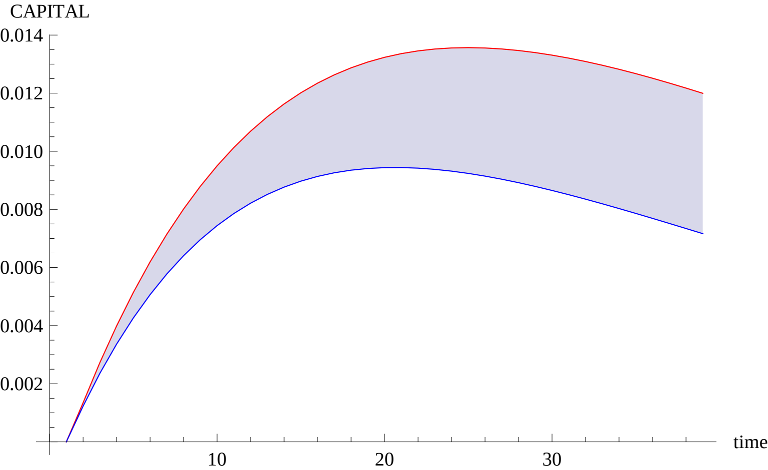
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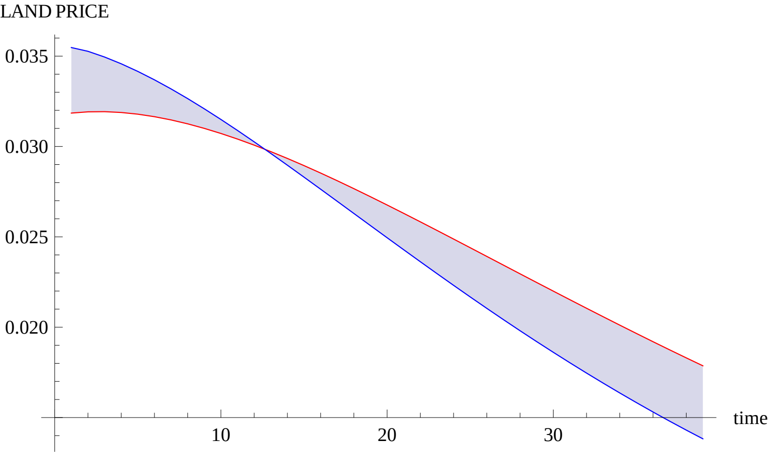
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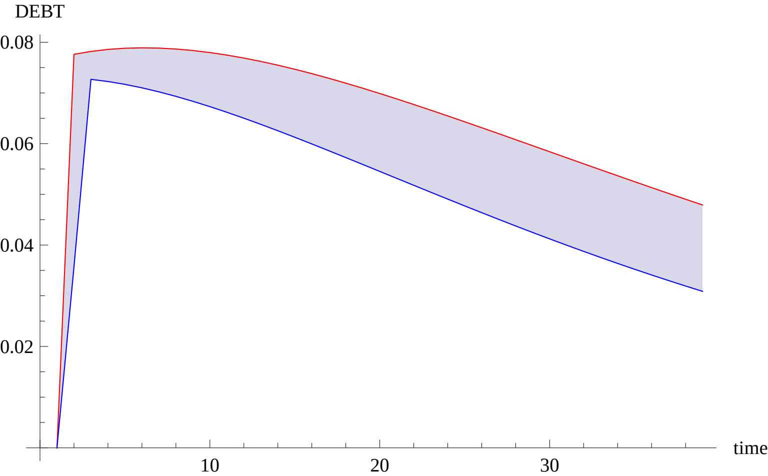
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- **Learning under procyclical leverage has larger effect:**
  - **hump-shaped response of output**
  - **significantly larger persistence**

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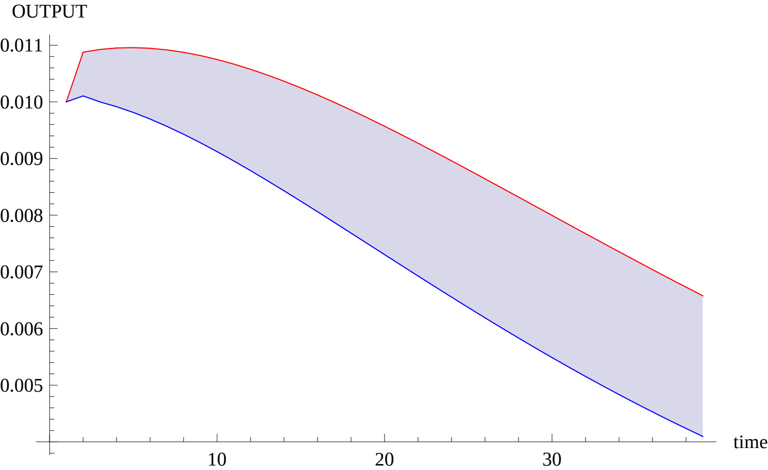
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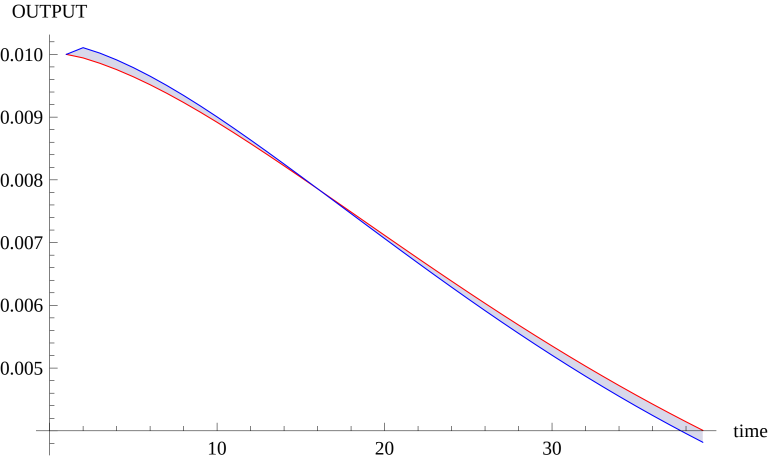
- **In contrast, setting** $\varepsilon = -2$ **(by regulation) would dampen output's response**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- **Future research:**
  - **micro-foundations needed!**
  - **structural change:** θ **vs** ε